REMARKS

This amendment is in response to the Office Action of March 1, 2001, and in response to the "Notice of Non-Compliant Amendment" of June 19, 2001. The present amendment corrects an informality in the earlier proposed amendment dated June 1, 2001 regarding the form of presenting changes to the specification. It is believed that this amendment is now fully compliant with 37 C.F.R. 1.121.

Claims 1-4 remain in this application. All claims are amended herein to more clearly define the invention and to further distinguish it from the prior art. Support for the amendments is found in the specification at page 9, lines 11-15; page 10, lines 14-20; page 11, lines 11-end; page 12, lines 1-23; and page 14, lines 5-12.

Attached hereto is a marked-up version of the changes made to the claims and specification by the current amendment. The attached pages are captioned **"Version with markings to show changes made."**

The drawing correction to FIG. 6 mentioned by the Examiner has now been made.

In paragraph 3 of the Office Action, the Examiner rejected the claims under 35 U.S.C. 103(a) as being unpatentable over Belson et al. U.S. Patent No. 3,644,806 or Belson et al. in view of the prior art of FIG. 6. Applicant submits that, in light of the amendments made herein, this ground of objection has now been overcome. Thus, amended claims 1-4 are now believed to be allowable.

Accordingly, applicants respectfully request that a timely Notice of Allowance be issued in this case.

If there are still unresolved issues requiring adverse action, it is requested that the Examiner contact applicants' attorney so that appropriate arrangements can be made for

discussing and perhaps resolving the same. Applicants' attorney can be reached at: (212) 661-8000.

If any further fees or extensions of time are required to maintain this application in pending condition, appropriate requests are hereby made, and authorization is given to debit Account Number 02-2275.

Respectfully submitted,

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"The Commissioner is hereby authorized to charge any fees under 37 CFR 1.16, 1.17 and 1.18 which may be required by this paper to Deposit Account No. 02-2275"

June 25, 2001 Donald C. Lucas

Date Signature

<u>Version with markings to show changes made</u>

<u>In the Claims:</u>

1. (Amended) A synchronization controller including controllers of a master section and [a] <u>at least one</u> slave section [both] <u>, each</u> for controlling an electric motor, said synchronization controller serving to accurately synchronize a rotational frequency and a rotation phase of <u>each</u> said electric motor or a machine shaft driven by <u>each</u> said electric motor, <u>each</u> said slave section controller comprising<u>:</u> [(a), (b), (c) as below therein,]

[(a)] a master rotational frequency [detection means] <u>detector</u> and a master phase [detection means] <u>counter</u> for detecting simultaneously at all times a rotational frequency signal and a phase signal from an output of a rotary encoder [belonging to] <u>coupled with</u> the electric motor [of] <u>in</u> the master section or from an output of a rotary encoder coupled with the machine shaft driven by said electric motor, <u>said rotary encoder comprising an incremental encoder with a Z phase pulse, and said master phase counter operating to count the output pulses of said encoder and being cleared with said Z phase pulse;</u>

[(b)] a slave rotational frequency [detection means] <u>detector</u> and a slave phase [detection means] <u>counter</u> for detecting simultaneously at all times a rotational frequency signal and a phase signal from an output of a rotary encoder [belonging to] <u>coupled with</u> the electric motor [of] <u>in</u> the slave section or from an output of a rotary encoder coupled with the machine shaft driven by said electric motor, <u>said rotary encoder comprising an incremental encoder with a Z phase pulse and said slave phase counter operating to count the output pulses of said encoder and being cleared with said Z phase pulse</u>; and

[(c)] a phase deviation [detection means] <u>calculator</u> for detecting a <u>rotational</u> phase

deviation from the outputs of said master phase [detection means] counter and said slave phase [detection means] counter at all times, according to counted overflow pulses and the counted output pulses of said master phase counter and said slave phase counter, there being matched an origin of the electric motor [of] in the master section and [it] an origin of the electric motor [of] in the slave section, or matched an origin of the machine shaft driven by the electric motor [of] in the master section and [it] an origin of the machine shaft driven by the electric motor [of] in the slave section [based upon the phase deviation detected by said phase deviation detection means] to achieve synchronous control.

2. (Amended) A synchronization controller including a controller of a slave section for controlling an electric motor, said synchronization controller serving to accurately synchronize a rotational frequency and rotation phase of said electric motor or a machine shaft driven by said electric motor with [a] rotational frequency signal pulses and a Z phase pulse signal electronically generated within and outputted from [the] a master section, said slave section controller comprising:

[(a)] a master rotational frequency [detection means] detector and a master phase [detection means] counter for simultaneously detecting the rotational frequency signal and the phase signal from an output of an incremental encoder with a Z phase pulse coupled with the electric motor in the master section or from an output of a rotary encoder coupled with the machine shaft driven by said electric motor outputted from the master section at all times, and said master phase counter operating to count the output signal pulses from said master section and being cleared with the Z phase pulse from said master section;

[(b)] a slave rotational frequency [detection means] detector and a slave phase [detection

means] counter for detecting simultaneously at all times the rotational frequency signal and the phase signal from an output of [a rotary encoder belonging to] an incremental encoder with a Z phase pulse coupled with the electric motor of the slave section or from an output [from a rotary encoder] of an incremental encoder with a Z phase pulse coupled with the machine shaft driven by the electric motor, and said slave phase counter operating to count the output pulses of said encoder and being cleared with said Z phase pulse; and

[(c)] a phase deviation [detection means] calculator for detecting a rotational phase deviation from the outputs of said master phase [detection means] counter and said slave phase [detection means] counter at all times, according to counted overflow pulses and the counted output pulses of said master phase counter and said slave phase counter, there being matched an origin of [the] said electric motor of the slave section or the machine shaft driven by [the] said electric motor based upon the phase deviation detected by said phase deviation [detection means] calculator to synchronize rotation phase of said electric motor or the machine shaft driven by said electric motor with the signal outputted from the master section.

3. (Amended) A synchronization control method including [an] a plurality of electric motors, each for driving [a] at least one rotating machine shaft and a controller for a master section and [a] at least one slave section [both] , each said controller for controlling one of said electric motors, said synchronization control method serving to accurately synchronize a rotational frequency and rotation phase of each said electric motor or the machine shaft driven by each said electric motor, comprising the steps of:

when [plural] all of said electric motors [for executing the synchronization control] start[s] [its] their operations from a stopped state, simultaneously detecting at all times a

rotational frequency signal and a phase signal from an output of an incremental rotary encoder with a Z phase pulse coupled with [of] the electric motor [of] in the master section or of a machine shaft driven by said electric motor [in the slave section] and further simultaneously detecting at all times a rotational frequency signal and a phase signal from an output of an incremental rotary encoder with a Z phase pulse coupled with [of] the electric motor [of] in the slave section or of the machine shaft driven by [the] said electric motor;

[obtaining] calculating a rotational phase deviation from said rotational frequency signal and said phase signal according to counted overflow pulses and counted output pulses of a master phase counter and a slave phase counter; and

matching origins of said electric motors [of] in each slave section or of the machine shafts driven by said electric motors based upon said phase deviation during acceleration of all number of the electric motors or after all number of [the] said electric motors reach a predetermined rotational frequency, and synchronizing the rotation phase of said electric motors or of the machine shafts driven by said electric motors with the phase signal outputted from the master section.

4. (Amended) A synchronization control method including [an] a plurality of electric motors, each for driving [a] at least one rotating machine shaft and a controller for each of a master section and a slave section, [both] each controller for controlling one of said electric motors, said synchronization control method serving to accurately synchronize a rotational frequency and rotation phase of each said electric motor or the machine shaft driven by each said electric motor, comprising the steps of:

[among the electric motors for effecting synchronization control there are some electric

motors under operation and others electric motors in operation] when some of said electric motors are in operation and others of said electric motors are under interruption and the operation of the electric motors under interruption is started, simultaneously detecting rotational frequency signals and phase signals from an output of an incremental rotary encoder with a Z phase pulse coupled with [of] the electric motor[s] [of] in the master section or the machine shaft[s] driven by said electric motor[s] at all times [in the slave section] and further simultaneously detecting the rotational frequency signals and the phase signals from an output of an incremental rotary encoder with a Z phase pulse coupled with [of] the electric motor[s] [of] in each [the] slave section or of the machine shaft[s] driven by each said electric motor[s] at all times;

[obtaining] calculating a rotational phase deviation from [the] said rotational frequency signals and said phase signals according to counted overflow pulses and counted output pulses of a master phase counter and a slave phase counter; and

matching origins of [the] said electric motors [of] in each slave section or of the machine shafts driven by [the] said electric motors based upon said phase deviation after said electric motors reach a predetermined rotational frequency to synchronize the rotation phase of [the] said electric motors or of the machine shafts driven by said electric motors with the phase signal outputted from the master section.

Version with markings to show changes made (cont.)

In the Specification:

[Page 5, lines 5-16:]

According to the present invention, for synchronization control of machine shafts driven by electric motors, one electric motor is disposed in a master section and the other one or plural electric motors is or are disposed in a slave section. A rotary encoder composed of an absolute encoder or [a Z phase equipped incremental encoder] an incremental encoder with a Z phase pulse is provided on the electric motors of the master section and the slave section or on machine shafts driven by the electric motors to output a signal in response to rotation of the electric motor or the machine shaft. For the aforesaid rotary encoder there may be employed one attached rotary each electric motor (rotary encoder mounted on the electric motor for detecting rotation of the electric motor), and the rotary encoder may be coupled with a machine shaft connected with a rotary shaft of each electric motor or coupled with a machine shaft connect through a gear and the like.

[Page 9, lines 11-20:]

In FIG. 1, Mm is an electric motor of the master section, Ms1, Ms2 are electric motors of the slave section, respectively, and Pm, Ps1, Ps2 are incremental encoders coupled with the aforesaid electric motors. For the rotary encoders coupled with the

electric motors of the master section and the slave section 1, 2, there is available an absolute encoder or [a Z phase equipped incremental encoder] <u>an incremental encoder with a Z phase pulse</u>. In the embodiment in FIG. 1, there is illustrated an example where there are used [the Z phase equipped incremental encoders] <u>incremental encoders with a Z phase pulse</u> Pm, Ps1, Ps2, in which controllers Am, As1 of the electric motors receive a Z phase pulse Zp once for one revolution of the electric motor and a pulse series Rp in response to the rotation of the electric motor from the incremental encoders Pm, Ps1, Ps2.

<u>[Page 11, line 20 to page 12, line 5:]</u>

Outputs of the master phase counter Cm1 and slave phase counter Cs1 are inputted into the phase deviation calculator Hs1, and the phase deviation calculator Hs1 calculates a phase deviation Hs in accordance with the following formula:

$$Hs = Nmax \times Covf + Cm - Cs \qquad (1)$$

In the formula (1), Nmax is a pulse number for one revolution of the [Z phase-equipped incremental encoders] <u>incremental encoders with a Z phase pulse</u> Pm, Ps1, and Covf is a counted value of overflow pulses of the master phase counter Cm1 and the slave phase counter Cs1 which value is added one by one every time the master phase counter Cm1 overflows and is subtracted one by one every time the slave phase counter Cs1 overflows. Cm and Cs are count values of the master phase counter Cm1 and the slave phase counter Cs1.